Methodological Issues When Assessing Dismounted Soldier Mobility Performance

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Background (1 of 3)

- Measures
  - Time
    - Appropriate for anaerobic activities (great exertion over short period of time)
  - Energy expenditure
    - Appropriate for aerobic activities (moderate exertion over long period of time)
- Dismounted Soldier Movements
  - Move Administratively
    - Aerobic activity
  - Move tactically but not in an engagement
    - Mostly aerobic activity
  - Move tactically while engaged
    - Anaerobic activity

Background (2 of 3)

- Physiological Effects of Load Carriage
  - Method
    - Walking or running on treadmill with backpack loads varying from 0 to 88 pounds
    - Heart rate and oxygen consumption measured
  - Findings
    - Prediction equations developed for energy expenditure of backpack load carriage during standing, walking, and running over various terrains and grades
    - Equations have a linear, quadratic, and cubic term for load carriage weight
    - Energy expenditure for weight carried in the hands is 30 to 40% higher than in rucksack

Background (3 of 3)

Physical Performance Effects of Load Carriage

- Method
  - Almost always a comparison of equipment configurations using an obstacle course, shooting, cross country course, and short road march
  - One meta-analysis of three studies with five equipment configurations (Harman et al, 2002)
- Findings
  - Developed a linear prediction equation for obstacle course completion time during load carriage (r-squared=0.28)
  - 0.43 second increase in time for each additional pound carried on 115 meter course (1.90 seconds when adjusted for a 500 meter course)

Problem and Objective

- PROBLEM
  - How do we trade off the increased combat effectiveness provided by the equipment with the decreased mobility associated with increasing the load carried by the soldier?

- OBJECTIVE
  - Derive a prediction equation for time to complete an obstacle course while carrying various weapons systems

Methods

- Data from thirteen studies conducted by the US Army Research Laboratory between 1973 and 2002
  - 500 m long obstacle course with 20 obstacles
  - Total weight carried ranging between 33 and 92 pounds (46 different equipment configurations)
- Stepwise Regression Analysis
  - Independent variables
    - Weight carried (in pounds, as a continuous variable)
    - Weapon system length (short [30 inches or less] & long [greater than 30 inches]
  - Dependent variable
    - Mean time to complete the obstacle course
  - Linear and non-linear analyses performed

500-Meter Mobility-Portability Course

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Results

- Linear relationship between load carried and time to complete obstacle course (r-squared=0.59, p<0.000)

  Time (sec) = 3.58*(load in pounds) + 175

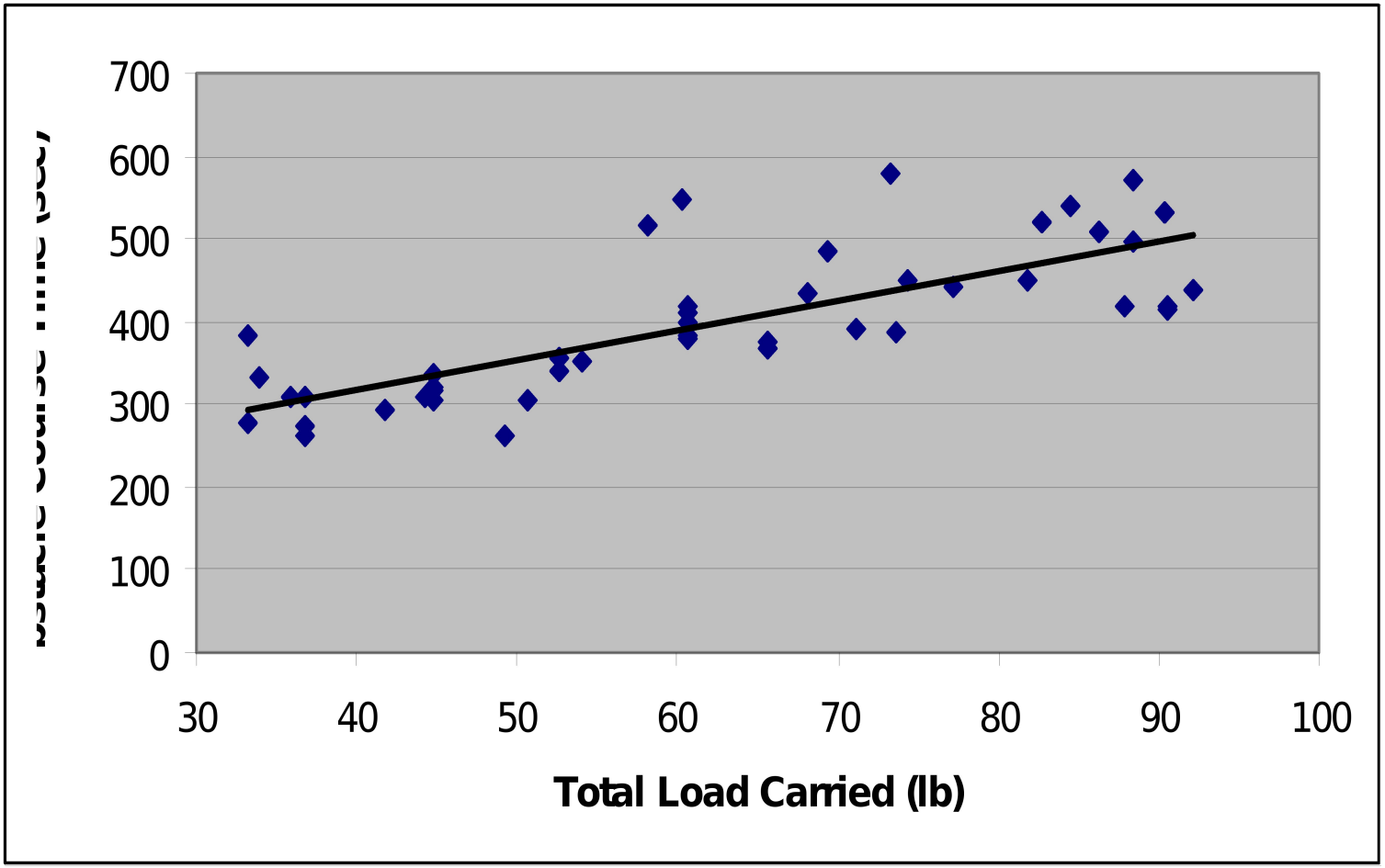
- Correlation between load carried and weapon system length (Kendall's tau-b=0.57, p<0.001)

Results That Were Not Significant

- After removing the effects of weight on time to complete obstacle course, no relationship was found between weapon system length and time to complete obstacle course

- Nonlinear relationships between weight of total load carried and time to complete obstacle course were not significant

Obstacle Course Time as a Function of Total Load Carried



Discussion

- Results similar to Harman et al (2002)
  - Linear relationship
  - Positive coefficient (3.58 versus 1.90)
- Factors not controlled
  - Distribution of load between hands and torso
  - Individual soldier body weight and fitness level
- Recommendations
  - Study systemically varying weight carried on torso and in hands including soldier APFT score and body weight
  - Develop a survivability index based on exposure time while moving

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